



# AMERICAN JOURNAL OF EDUCATION AND TECHNOLOGY (AJET)

ISSN: 2832-9481 (ONLINE)

VOLUME 2 ISSUE 2 (2023)



PUBLISHED BY  
E-PALLI PUBLISHERS, DELAWARE, USA

## Comparative Study of Traditional Face-to-Face and E-Learning Modes of Teaching Senior High School Geometry

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### Article Information

**Received:** March 09, 2023

**Accepted:** April 05, 2023

**Published:** April 11, 2023

### Keywords

*E-Learning Mode, Traditional Face-to-Face Mode, Students' Performance and Retention*

### ABSTRACT

This study compared the traditional face-to-face and e-learning modes of teaching Senior High School geometry and students' geometry performance. The study used a quantitative strategy which adopted a quasi-experimental design with pre-test and post-test non-equivalent control groups. Pre-test, post-test and retention test were used for the data collection. A total number of 52 second-year Senior High School students from two public schools in the Suame Municipality of the Ashanti Region of Ghana participated in the study. Students' Geometry Achievement Test (SGAT) was used as pre-test, post-test and retention test instruments. The data was analysed using descriptive statistics and a t-test tested at a 0.05 significance level. The findings of the study revealed no significant difference in the post-test mean scores of students taught face-to-face and those taught using the e-learning mode even though there was a significant improvement in the performance of students after the intervention. Again, there was no significant difference in the retention test mean scores of the students taught using the face-to-face mode and those taught using the e-learning mode. The study, therefore, recommended that; policy makers in general, and mathematics curriculum developers in particular, plan and implement electronic learning modules to facilitate and enhance the teaching and learning of mathematics. It was again recommended that teachers take advantage of the new technology-driven world to blend the traditional face-to-face and e-learning modes of teaching to facilitate and enhance the teaching and learning of mathematics.

### INTRODUCTION

Mathematics is a science that studies patterns, shapes, symbols, numbers, and the relationship between them. Mathematics occupies a crucial and specific position in human society and represents a strategic key for the development and improvement of the whole of mankind. Human existence would have been meaningless without the knowledge of geometry; hence our lives revolve around geometry. Without an understanding of geometry, one cannot construct, mould, go to space, or create any kind of thing. Mathematics is significant not just for its contributions to the growth of science and technology, but also for how varied members of society use it in everyday interactions at jobs, markets, transit hubs, and businesses of all kinds (Golji & Dangpe, 2016). The corona virus outbreak and its subsequent declaration as a pandemic by the World Health Organisation (WHO) exposed the existence of inequalities in access and quality education in Ghana. During the pandemic, schools were closed down without adequate alternative measures to access formal education for children, especially basic and Senior High Schools nationwide (UNICEF Ghana, 2021). This pandemic has tested our technological and digital development and advancement, especially in Ghana. The pandemic led to the closure of schools worldwide, leaving most learners across educational levels without access to formal education for about a year. Although e-learning platforms like the Joy learning channel, uLesson, and the Centre for National E-learning

and Open Schooling (CENDLOS) which include iBox, iCampus, and other programs were designed and implemented in Ghana to enable underprivileged children to have access to educational content with or without the internet nationwide, these services were not equitably accessed since there were a good number of school children without access to mobile devices, televisions, and internet.

Disparities in access to and participation in e-learning activities were seen throughout the period of the corona virus pandemic, particularly in 2020 when many institutions were locked down globally, as reported by Wolf *et al.* (2021). Students in higher education institutions and private schools with enough resources, and kids from families with higher socio-economic status participated in on-line or remote learning and received more assistance from their schools and parents or other adult caregivers in Ghana. The other levels of public basic and Senior High Schools remained closed while the final-year students were provided special access to the traditional teacher-student face-to-face interactions to enable them to write their final examinations. Due to the epidemic, schools were forced to close, which has prompted a review of how education is delivered in Ghana's public senior high schools. According to Abbad and Jaber (2014), technological advancements and innovations increase the pressure on institutions to shift from face-to-face to on-line instruction as the world becomes more digital.

E-learning is an essential learning and teaching tool in

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today's technologically advanced society, particularly in light of the impact of the outbreak of the corona virus worldwide. The implementation of innovative didactic techniques and methodology in teaching mathematics in our second-cycle institutions is a result of the technology-focused approach to education. We have had to re-evaluate how we offer educational possibilities, particularly at Ghana's basic and second-cycle institutions, due to the corona virus outbreak and its impact on education. To improve the country's new educational delivery landscape, Senior High Schools in Ghana must explore digital and technological platforms; electronic learning (E-learning) is the most reliable option.

### Statement of the Problem

As a result of the global spread of COVID-19 and its devastating effects on educational services, there has been a dramatic shift away from the more conventional face-to-face method of instruction in favour of e-learning. This is done to guarantee that educational services will still be provided even if the pandemic spreads. Given the state of the globe since the COVID-19 pandemic and the prevalence of modern technology, on-line education is essential. This focus on technology in the classroom calls for the adoption of novel pedagogical approaches and didactic strategies in the study and instruction of mathematics in our high schools. In light of the recent COVID-19 pandemic, we have re-evaluated how we deliver education in Ghana, particularly at the primary and secondary levels. To adapt to the changing environment of education in Ghana, senior high schools should investigate the potential of electronic learning (E-learning) through the internet and other digital and technology platforms.

The effectiveness and success of e-learning (e-learning) are being discussed in the increasing educational delivery around the world. Whether or not on-line education is as effective as classroom instruction is still an open subject. Many academic studies have attempted to find solutions to this problem, but senior high schools in Ghana are not implementing any of them. Therefore, this research examines the effectiveness of using traditional classroom instruction and e-learning to teach geometry to senior high school students in the Suame Municipality of the Ashanti Region of Ghana.

### Research Objectives

The overarching research objective of this study is to examine the effectiveness of using both traditional face-to-face and e-learning to teach geometry to senior high school students in the Suame Municipality in the Ashanti Region of Ghana. The specific objectives of the study sought to:

1. find out whether there is a difference between the post-test mean scores of the students taught using face-to-face and those taught using e-learning modes.
2. determine whether there is a difference in the retention test mean scores of the students taught using

the traditional face-to-face and those taught using e-learning modes.

### Research Hypotheses

To answer the specific objectives of the study, the following null hypotheses were formulated and tested at a 0.05 level of significance. They are as follows:

- i. H01: There is no significant difference in the post-test mean scores of the students taught using face-to-face and those taught using e-learning modes.
- ii. H02: There is no significant difference in the retention test mean scores of the students taught using the traditional face-to-face and those taught using e-learning modes.

### LITERATURE REVIEW

According to Rajab (2018), the findings of his research indicated that e-learning not only helps schools save money on infrastructure development and human resources, but also makes education more accessible, equitable, sustainable, and simple. After describing the "battle between Saudi Arabia, the Arab Coalition, and Yemeni rebel groups," he went on to address the potential advantages of remote or electronic schooling in combat zones like Saudi Arabia. After the war, colleges shifted to provide education exclusively through online courses. According to the study, pupils who were unable to attend traditional classrooms due to ongoing violence benefited greatly from the "accessible and high-quality education" given by e-learning platforms. The purpose of this study was to identify possible responses to the crisis's influence on academic pursuits. There are fewer opportunities for "access to high-quality education" in places like war zones and countries hit hard by natural catastrophes, civil strife, and pandemics. Miller, Rocconi, and Dumford (2018) state that students would have less opportunity for cooperative learning in on-line classes due to the lack of physical connection between students and teachers and between students themselves.

Boelens, De Wever, and Voet (2017) examined the efficacy of on-line versus face-to-face instruction in an introductory statistics course for undergraduates. The results showed no statistically significant difference in outcomes between traditional classroom settings and online instruction. Using master's level Corporate Consulting and Training International (CCTI) courses, Singh and Thurman (2019) studied how students benefited from taking their classes on-line. The results showed that on-line education was more effective in raising students' test scores than traditional classroom instruction. Khader (2016) did research to find out if online or hybrid education helps college students learn more effectively. According to the findings, exposure to educational content online enhances college students' ability to acquire and retain information.

Almahasees, Mohsen, and Amin (2021) found that during the corona virus pandemic, both faculty (lecturers and senior members) and students agreed that electronic



learning was beneficial and at the same time lacked effectiveness as compared to the conventional mode of learning and teaching. The most challenging aspects of on-line or electronic learning, according to the faculty members and students, are an adaptation to the e-learning mode. The main advantages were that it was easy to teach oneself, cheap, and convenient. The importance of teachers in promoting e-learning and teaching and enhancing communication between students and professors or management and among students was highlighted in a study on the perspectives and attitudes of faculty members and students regarding e-learning and on-line education. Since the widespread lock down caused by the Covid-19 pandemic, traditional classroom instruction has given way to e-learning, sometimes known as distance education. Because of this change, schools may now educate students on how to use cutting-edge technology tools while they're still in school, which is in everyone's best interest (Isaeva, Eisenschmidt, Vanari & Kumpas-Lenk, 2020). Similarly, in on-line laboratory courses, students' perspectives were ignored in many ways (Beck & Blumer, 2016).

According to Butnaru, Niță, Anichiti, and Brînză (2021), students who value traditional classroom participation value interaction with academia for the conventional face-to-face meetings with professors and interaction among students as well as for the instant feedback generated by the stated circumstance. In the pre-academic environment, high school students have similar perceptions. There are some issues with transferring content from a traditional learning and teaching format to an on-line education format, and there are perception differences. As a result of the effects of e-learning, such as limited interaction with the school's physical environment and classmates, as well as increased interaction with technology, students regard on-line courses as ineffective (Olayemi, Adamu & Olayemi, 2021).

Yates, Starkey, Egerton, and Flueggen (2021) investigated the effectiveness of the e-learning mode of education delivery in the context of the corona virus outbreak. The findings of the study indicated that during the Covid-19 pandemic, an e-learning strategy was the best alternative to the conventional face-to-face mode of learning and teaching. However, they also mentioned some issues with e-learning, such as students' unwillingness to listen to the lecturer for an extended period, network and internet connectivity, video and audio problems, network coverage issues, and financial problems of parents and guidance during the period of the pandemic, as a result, the collapse of some businesses and the closing down of markets. The findings revealed that there were no statistical differences in the academic performance of postgraduate students who learned on-line and those who learn through the conventional mode of learning and teaching. In general, students performed admirably when it came to e-learning or e-learning, on-line education delivery had a higher mean value of students' academic performance when compared to the conventional mode of instruction and

learning. It was noted that some students accomplished well in traditional classroom settings but poorly in on-line or e-learning settings (Hafeez, Ajmal & Zulfiqar, 2022).

## METHODOLOGY

The study used a quantitative strategy which adopted a quasi-experimental design with pre-test and post-test non-equivalent control groups. This research employed a quasi-experimental design because the e-learning group students were chosen using a purposive sample technique. This became essential since the researcher was unable to provide smartphones to all participants, hence students with access to smartphones were selected for the study. Again, an intact class was chosen for the face-to-face group to avoid disrupting contact hours since school authorities were not prepared for such a circumstance. All of this indicates that a true experiment cannot be performed owing to the nature of the selection techniques, necessitating the use of a quasi-experimental research design.

A total of 1, 860 form two Senior High School students was the target population. A total of fifty-two (52) students participated in the study; this included twenty-seven (27) students from Pentecost Senior High School and twenty-five (25) students from Osei Kyeretwei Senior High School. Data for the study was collected using the Students' Geometry Achievement Test (SGAT). Past questions from the West African Senior High School Certificate Examination (WASSCE) served as the basis for the items on the SGAT. First, mathematics professionals served as a focus group for the test items to guarantee their face and content validity, and second, mathematics department heads provided their input. The experts in the field of mathematics education were given the objectives of the study and questions to help direct their work. The experts were tasked to assess the validity of the instrument by considering how well the questions aligned with the stated objectives. The revised Students' Geometry Achievement Test (SGAT) reflects their input. Forty-five students from Bawku Senior High School in the Bawku Municipality of the Upper East Region participated in a pilot test of the research instruments (SGAT). The instrument was given to the responders and then given to them again two weeks later, as part of the test-retest procedure. Using the Pearson Product-moment Correlation Coefficient, the researchers determined that the test-retest findings of the study were internally consistent (well correlated), with a value of 0.78. This value shows a positive correlation between the two sets of results and hence the test items were deemed appropriate and fit for use.

The intervention process lasted for six weeks after the pre-test. The post-test followed immediately afterwards, while the retention test was conducted two months after the intervention. The control group was taught through conventional teacher-student face-to-face interactions and the experimental group was taught through on-line and other e-learning media. Descriptive statistics and an

independent t-test at a 0.05 confidence interval were used to answer the research hypothesis.

## RESULTS

**H01:** There is no significant difference in the post-test mean scores of the students taught using face-to-face and those taught using e-learning modes. An analysis of the pre-test and post-test mean scores for both traditional face-to-face and e-learning groups was conducted to test this null hypothesis.

Table 1 shows the pre-test analysis for both the traditional face-to-face and e-learning groups. This test was carried out before treatment.

Table 1 revealed no significant difference in the pre-test mean scores of the traditional face-to-face group (Mean = 3.28, SD = 3.31) and e-learning groups (Mean = 3.30, SD = 3.94),  $t(50) = 0.016$ ,  $\text{sig} = 0.987$ . This implies that students in each treatment group had equal academic ability in geometry before the intervention.

Table 2 revealed that there is no significant difference in the post-test mean scores of the face-to-face (Mean = 10.12, SD = 3.98) and e-learning groups (Mean = 10.11, SD = 5.23),  $t(50) = -0.007$ ,  $\text{sig} = 0.995$ . The null hypothesis is therefore tenable; therefore, we can conclude that the academic performance of students in each treatment group does not significantly differ in the study.

**Table 1:** Independent Sample T-test Statistics of the Pre-test Mean Scores

Group	N	Mean	SD	t	df	Sig. (2-tailed)
Face-to-face	25	3.28	3.31	.016	50	.987
E-learning	27	3.30	3.94			

Source: Field Survey, 2022

**Table 2:** Independent Sample T-test Statistics of the Post-test Mean Scores

Group	N	Mean	SD	t	df	Sig. (2-tailed)
Face-to-face	25	10.12	3.98	-.007	50	.995
E-learning	27	10.11	5.23			

Source: Field Survey, 2022

**H02:** There is no significant difference in the retention test mean scores of the students taught using face-to-face and those taught using e-learning modes. An analysis of the retention test means scores for both traditional face-to-face and e-learning groups was conducted to test this null hypothesis.

Table 3 revealed that there is no significant difference

in the retention test mean scores of the face-to-face (Mean = 12.60, SD = 4.15) and e-learning groups (Mean = 12.56, SD = 4.67),  $t(50) = -0.036$ ,  $\text{sig} = 0.971$ . We, therefore, failed to reject the null hypothesis and conclude that students in each treatment group had no significant difference in retaining the concepts learnt during the study.

**Table 3:** Independent Sample T-test Statistics of the Retention Test Mean Scores

Group	N	Mean	SD	t	df	Sig. (2-tailed)
Face-to-face	25	12.60	4.15	-.036	50	.971
E-learning	27	12.56	4.67			

Source: Field Survey, 2022

## DISCUSSION

The results analyses revealed that there was a significant improvement in students' academic performance in geometry in both the conventional face-to-face teaching mode and the e-learning mode of teaching after treatment. No significant difference in students' academic performance in geometry from the post-test results analysis of the traditional face-to-face mode of teaching and e-learning mode of teaching was established. Hence, we failed to reject the null hypothesis that stated that there exists no significant difference in the achievement scores of students who were taught geometry through the traditional face-to-face teaching mode and those taught through the e-learning mode of teaching and therefore conclude that the e-learning mode produces the same academic outcome as compared to the traditional face-to-face mode. This finding resonates with the findings of Sussman & Dutter (2010), Rajab (2018); Boelens *et al.*

(2017) and Singh & Thurman (2019) whose studies showed that the e-learning mode produces the same academic outcomes

Again, the study revealed no significant difference in the retention test mean scores of the students who were taught geometry through the conventional face-to-face and e-learning modes. This means that the retention level of students in each treatment group did not significantly as reflected in their performance based on the retention test scores. These findings are in agreement with the findings of Sussman & Dutter (2010), Rajab (2018), Boelens, *et al.* (2017), Singh & Thurman (2019), Almahasees, *et al.* (2021) and Hafeez, *et al.* (2022) where remote learning mode of instruction was compared to the traditional face-to-face mode of teaching and learning which findings showed no significant difference in the academic performance of students based on the mode of instruction. The findings of the study also confirm the assertion by Yates, *et al.*

(2021) and Miller, *et al.* (2018) that remote learning was the best alternative to the face-to-face teaching mode during the corona virus outbreak. They concluded in their study that remote learning was effective, efficient, timely, easy to access, convenient and equitable. Nonetheless, they admitted that there were some challenges such as students' unwillingness to listen to lecturers or teachers for an extended period, issues with login, issues with internet connectivity and coverage, and issues with video and voice during live sessions of the e-learning mode.

## CONCLUSION

Comparatively, the academic outcome of E-learning mode of teaching and learning and traditional face-to-face does not differ significantly. This dispels the notion that the e-learning mode is not effective as compared to the conventional face-to-face mode. Again, both the traditional face-to-face and e-learning modes have no different effects on student's retention per the outcome of the study.

## RECOMMENDATION

It is recommended that policy makers in general, and mathematics curriculum developers in particular, plan and implement electronic learning modules to facilitate and enhance the teaching and learning of mathematics. Teachers should also take advantage of the new technology-driven world to blend the traditional face-to-face and e-learning modes of teaching to facilitate and enhance teaching and learning.

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